(12) UK Patent Application (19) GB (11) 2 379 946 (13) A

(43) Date of A Publication 26.03.2003

(21) Application No 0221863.4

(22) Date of Filing 20.09.2002

(30) Priority Data
(31) 0122668 (32) 20.09.2001 (33) GB

(71) Applicant(s)
Seaflex Limited
(Incorporated in the United Kingdom)
Samuel Whites, COWES, Isle of Wight,
PO31 7RA, United Kingdom

(72) Inventor(s)
Mark Lydon Board

(74) Agent and/or Address for Service
Nigel Brooks
Hill Hampton, East Meon, PETERSFIELD,
Hampshire, GU32 1QN, United Kingdom

(51) INT CL[7]
E04B 1/98 , E04H 9/10

(52) UK CL (Edition V)
E1D DF115 DGS2 DLEQW2 D154 D2019 D2038 D401 D428
E1G G53E

(56) Documents Cited
GB 2335447 A GB 2299606 A
WO 1997/025551 A US 3957098 A

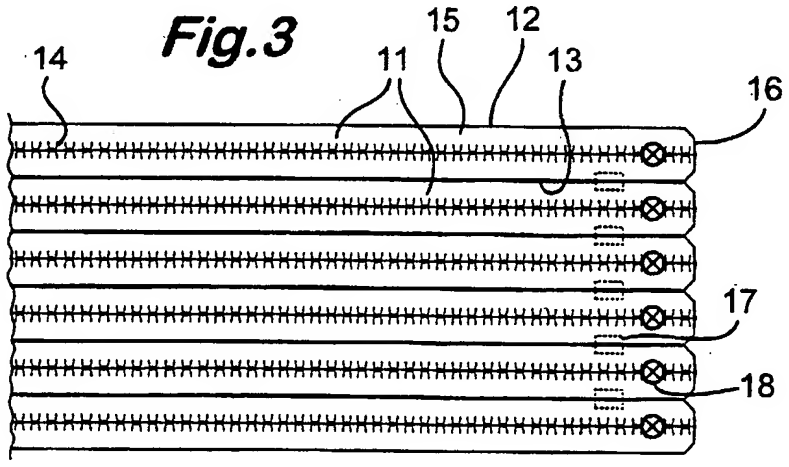
(58) Field of Search
UK CL (Edition T) E1D, E1G
INT CL[7] E04B, E04H
Other: EPODOC, WPI & JAPIO

(54) Abstract Title
Blast protection structure

(57) A blast protection wall comprises six individual containers 11 having a width appropriate to the wall. They have top and bottom skins 12,13 of drop-stitch fabric, that is with interconnecting stitches 14. The sides 15 and ends 16 are of similar fabric, stitched and sealed to top and bottom to form a water tight container. Between the top skin of one container and the bottom of the next, interconnections 17 are provided with pressure release valves arranged to release at a small differential pressure whereby the containers fill from the bottom upwards. The bottom container has a filling cock 18 for filling of the wall with water.

The containers (11) may also be used to form a pathway.

Fig.3



GB 2 379 946 A

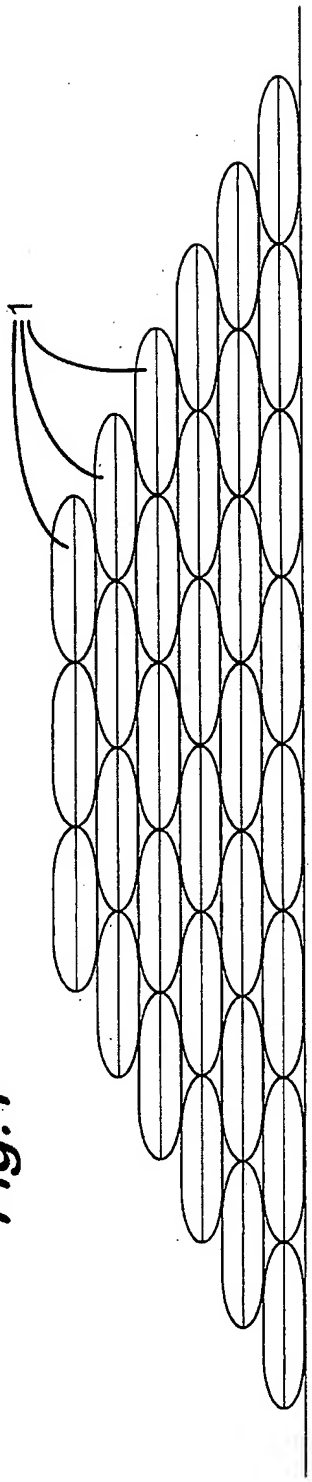


Fig. 1

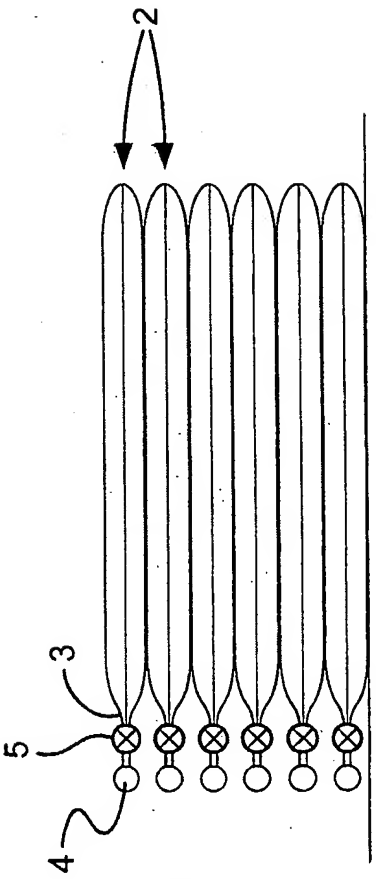


Fig.2

Fig.3

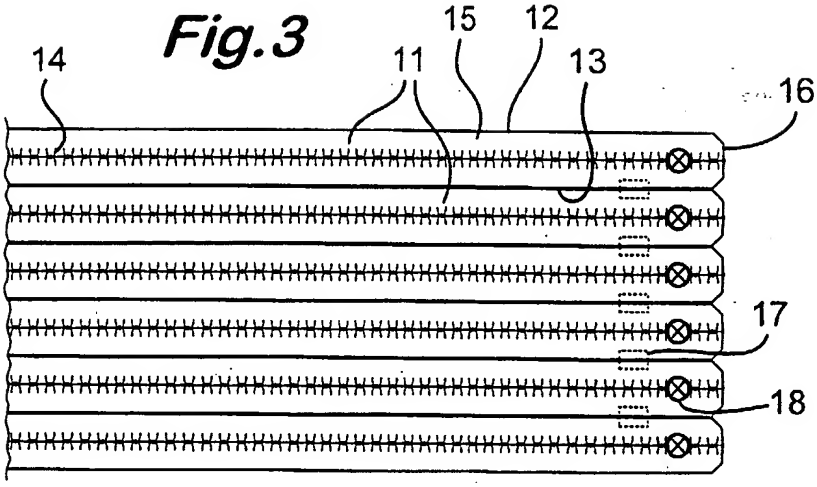


Fig.4

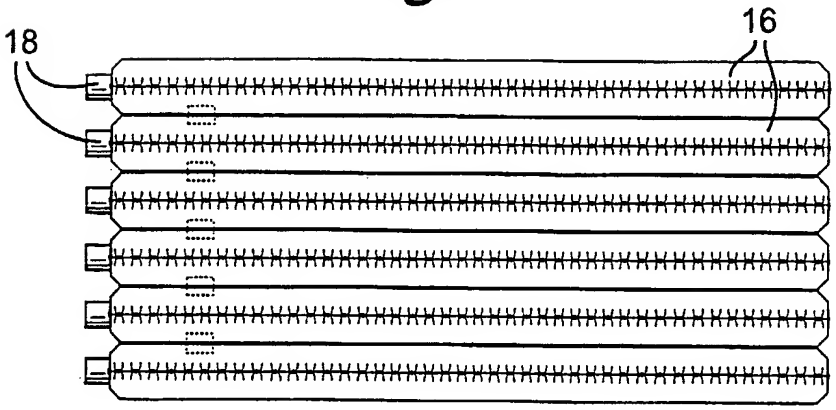


Fig.5

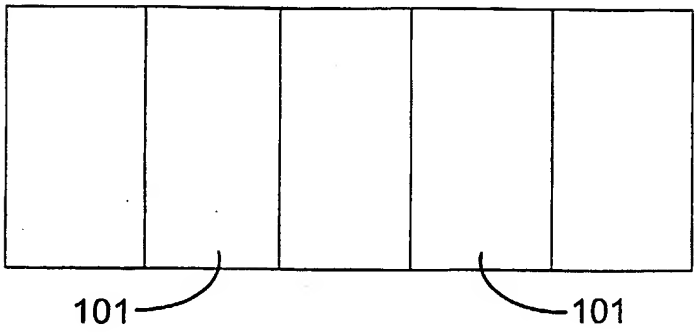


Fig.6

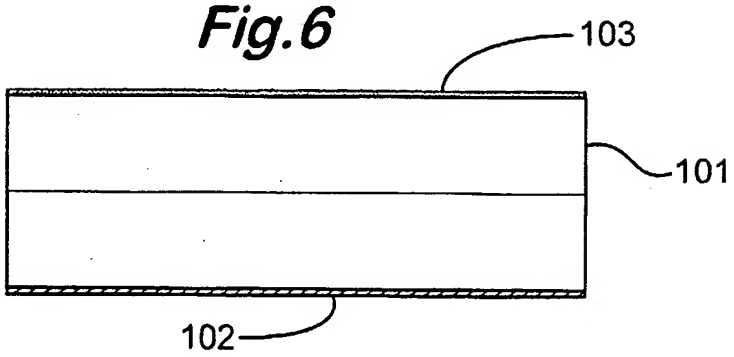
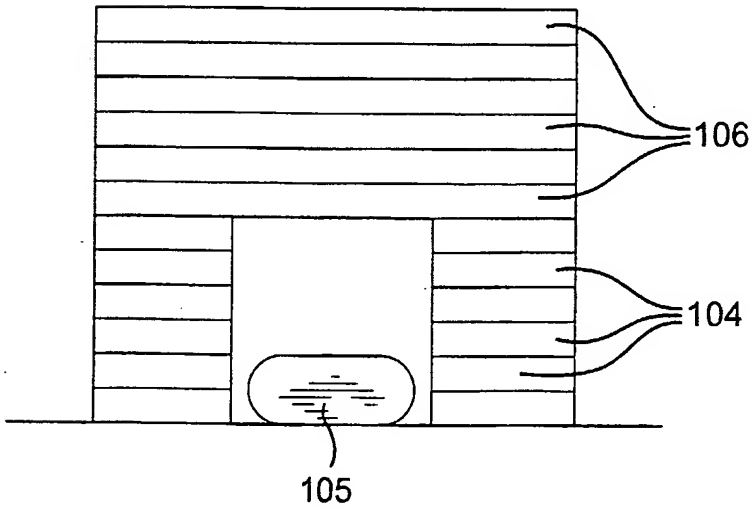


Fig.7



Blast Protection Structures

This invention relates to blast protection structures and in particular to bags used to make blast protection walls and roadways.

Blasts, usually caused by an explosion, involve debris and/or missiles etc. being thrown through the air and potentially causing damage to life and property.

A classic temporary blast protection wall is made of sandbags. These absorb the impact of the debris, whose kinetic energy is dissipated in displacing the sand. Thus although sandbags are of proven value, they do have drawbacks. They are time consuming and not that easy to fill. They generally have to be filled at least a short distance away from where the wall is to be built, and hence have to be carried there after filling. Further, a suitable filling material is not always readily available, and once the need for the wall is over, emptying the bags and disposing of the filling material can be as problematic as filling them and building the wall in the first place.

An alternative that has been in more recent use, comprises tanks of water, built up like bricks. The tanks are generally of black or at least dark plastics material and are substantially rigid. They are fairly light when empty, and so courses of tanks can easily be placed one adjacent another to form a wall, and then filled in situ from a hose, using either a local water supply or a tanker. But they are bulky items to store and transport, and they cannot readily be made to nest together in a compact stack. They have to be closed vessels. Also, being opaque, they cannot be checked at a glance to see whether they are full or empty.

Also it has been proposed to suspend water filled containers from a metal framework as an anti-blast wall. However, such a wall requires for the framework to be transported to site and assembled there. This can be time consuming and should the water be insufficient in slowing the debris, the metal framework itself can become part of the debris which was intended to be contained.

It is an object of the present invention to overcome, or at least ameliorate these disadvantages, and in particular to provide an improved anti-blast wall.

According to the present invention, there is provided a blast protection structure comprising one or more rupturable containers, each of said rupturable containers being formed of a flexible bag having a aperture and filler cap so that fluid can be introduced into the bag and sealed therein, to give substantial rigidity to said rupturable container and to provide blast protection.

The flexible bags have flexible skins, whereby the respective skins of adjacent containers abut to substantially eliminate voids between the containers, through which explosive debris might pass without impacting the contained fluid and dissipating energy to the fluid in so doing.

It is envisaged, that the fluid may be a combination of water and air, introduced sequentially into the bag. It is preferred that the bags should be completely water filled, since if there is an explosion, the water will be a far more effective suppressant than air. However there may be occasions when water is insufficient in quantity or is even not available, but there is a compressor available.

For some purposes, the blast protection structure may have bags which are divided into internal chambers, preferably one above the other with the lowermost chamber having a reinforcement layer.

It is envisaged the bag may be divided into two chambers, with the reinforcement layer being Kevlar ®.

Preferably the uppermost chamber of the bag has an external non-slip coating. This coating may be integral with the material making up the bag or it may be a non-slip layer which is applied to the bag after manufacture. The non-slip coating reduces the risk of adjacent bags from moving relative to one another, so weakening the structure.

It is preferred that the flexible bags have tongues and grooves or rebates to enable adjacent flexible bags to be interlocked or to have some degree of

interengagement. Further, the bags, which will generally be of already referred to reinforcement plastics material, may be fabric reinforced throughout, and they can be constructed with internal webs or ties so that when in position they approximate a solid block and not bulge excessively.

In one embodiment, the containers are laid with their length arranged width-wise of the wall, whose length is built up with increasing numbers of containers.

In another embodiment, the containers are laid length-wise, having a width appropriate to the width of the wall.

Preferably the containers, or sets of them, are interconnected for their filling from a single hydrant. Conveniently, the interconnections will include pressure relief valves and a hydrant connection to the lowest container, whereby the lowest container is filled first and each container up in the wall is filled next.

The containers can be of waterproofed fabric material. To restrain the containers to a generally rectangular cross-section, the fabric of the top and bottom is conveniently of so-called drop stitch fabric, whereby the top and bottom skins are restrained to be parallel with each other. The sides and ends are stitched and/or welded on in a water-tight manner. Such containers per se are known for storing fluids.

Further it is envisaged that a blast protection structure may be formed whereby the flexible bags are used in conjunction with rigid containers to provide blast protection. Provision may be made for the bags to leave gaps for access by cameras or robotic arms, or even by human hands. These gaps do not have to be very large and measures can be taken to mitigate the effect of any blast escaping through them. An example of such measures could be the inclusion of meshing.

One type of blast protection structure is formed by flexible bags which are assembled in layers. It may be a simple wall, or a more complex arrangement such as a plurality of sealable bags assembled into a hood-like structure which is enlarged and stablised by the bags being filled with liquid.

Bags arranged in layers will generally be filled from the bottom layer upwards. In a simple form, a dome is created, which can be quickly assembled over a suspect package or container, for example, and when complete any explosions should be largely or even completely contained within the dome. The bags may suffer irreparable damage and the surrounding areas may be flooded in a limited way, but this is not as life threatening as an explosion. Further, the release of liquid would help to extinguish any flames or fire that is produced or suppress any smoke and it is the density of liquid that allows for such actions.

It is further envisaged that a blast protection structure may be formed by filled bags linked to one another to form a linear structure. Preferably, the linear structure forms a pathway over which persons or vehicles may travel.

Such a structure may provide a temporary path or roadway for laying over hazardous ground. It comprises a plurality of sealable bags linked to be capable of being rolled out or distributed from a bundle into a interim path or roadway, this being completed by filling the bags with fluid.

Thus, when confronted with a mine field, a bundle of these bags can be unrolled in front of the user, or attached one by one in sequence to a growing path or roadway, the bags being successively filled to make them semi-rigid before any substantial weight is imposed on them. Concentrated load on the upper surface will be dissipated into a low unit area pressure on the ground and absorbed or imparted to the surrounding ground by the lower under surface. For example, a foot fall that would set off a personnel mine if there was direct contact has its effect spread so that there is not sufficient pressure on the mine, if beneath the path, for it to be detonated. On a larger scale, the wheels of a truck would not set off a vehicle mine beneath a load spreading roadway. Also, of course in the case of air-filled bags, buoyancy provided by the air-filled bags would serve better if swampy ground is to be traversed.

In building blast protection structures according to the invention, whether they be

for a dome structure, wall or a linear structure forming a roadway, a course of empty bags can be laid out, filled in situ, followed by another course of empty bags and so on.

When no longer needed each bag can be emptied simply by pulling a plug, and once emptied the bags can be rolled or folded into compact form for transport and storage.

Apart from filler caps and drain plugs, there need be no rigid parts so that, in the event of a blast, there is initially no hazard from flying shards of metal or substantially rigid plastics material.

Should any bag be punctured and leak, this will be soon, if not immediately, apparent from a sag in the wall and a visible trickle or spurt of water, and remedial action can be taken.

To help understanding of the invention, a specific embodiment thereof will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a side view of a first anti-blast wall of the invention;

Figure 2 is an end view of the wall of Figure 1;

Figure 3 is a side view of a second anti-blast wall of the invention;

Figure 4 is an end view of the wall of Figure 3;

Figure 5 is a plan view of a temporary path constructed from water-filled bags;

Figure 6 is a cross-section of one such bag; and

Figure 7 is a cross-section of a protective shield.

Referring to Figures 1 and 2, the wall thereshown comprises a plurality of pillow shaped 1 containers laid as a series of six "header" courses 2, that is to say with the length of containers extending across the width of the wall.

Each container has a connection 3 to a respective manifold 4 for the course. The courses can then be filled from the bottom upwards. The manifold can be moved up to the next course after filling of each and isolation of the individual connections.

Alternatively, each course can have its own manifold, with isolation being provided collectively by a stop cock 5 at the end of the manifold.

Referring on to Figures 3 and 4, the wall thereshown comprises six individual containers 11 having a width appropriate to the wall. They have top and bottom skins 12,13 of drop-stitch fabric, that is with interconnecting stitches 14. The sides 15 and ends 16 are of similar fabric, stitched and sealed to top and bottom to form a water tight container. Between the top skin of one container and the bottom of the next, interconnections 17 are provided with pressure release valves arranged to release at a small differential pressure whereby the containers fill from the bottom upwards. The bottom container has a filling cock 18. Indeed each container is provided with a cock 18, so that they can all be emptied after use of the wall. It is believed that this configuration of wall will be particularly convenient in enabling the wall to be delivered to site for use in a roll, which can be spread out and quickly filled. The cocks and interconnections are of plastics material, whereby use of metal components which might be propelled by a blast is avoided.

Typical dimensions of the filled wall are:

- depth of the containers 11 300mm
- width of the containers 11 1500mm
- length of the containers 11 indefinite.

Whilst the six container wall has a height of 1800mm, it is expected that the height of the wall – by use of more containers – could be twice its width, i.e. 3m with 10 containers. The depth of the containers can vary between 65mm and 475mm.

In use, the wall is rolled out where required and filled as above. Should a blast occur, the containers will of course be completely destroyed. However the blast debris will encounter the water of the wall before this flows away and will have to displace substantial quantities of water to penetrate the wall. A test has demonstrated that a taxis

exploded with 20kg of fertiliser next to wall of Figures 1 & 2 constructed of 2m long containers allowed no flying debris to penetrate the wall.

The path of Figure 5 is made up from a plurality of elongate watertight bags 101, transverse to the direction of the path. When empty they can be rolled up, and when rolled out flat they can be filled with water sequentially so that each bag becomes hard, but not absolutely rigid. They are preferably made of drop-stitch material, as mentioned above, so that the path is generally flat.

Each bag is double chambered, one above the other as shown in Figure 6. The underside 102 is sheathed in the material known as Kevlar, as protection against rough surfaces and for blast mitigation. The upper surface 103 has a non-slip coating or layer applied to it. Typically the total depth might be of the order of 200mm (each chamber 100mm) and the dimension in the longitudinal direction of the path 1.45m. The width can be selected as desired.

In Figure 7, a set of annular bags 104 can be built up into a drum-like wall to surround a device 105 that might explode. This wall is capped by several disc-like bags 106, roofing over the device 104.

In the wall construction, empty bags are placed in position before being filled and they can be constructed with internal ties so that they do not bulge, but form flat topped pillars, which can lie in stable courses, one above the other.

The bags are filled sequentially from the bottom, and when the structure is complete there is quite a mass of contained water over the device, and thick walls of compressed water bags around it. An explosion will be largely if not completely contained.

If a blast is thought to be imminent and if no protection exists, this waterbag protection can often be put in place and erected without a person approaching the blast source, such as a suspected parcel bomb. Empty pre-linked bags can be carried robotically into proximity of the blast source trailing pre-connected hoses. The bags can

be filled from a distance, building up a protective structure in front of, or even around and over, the danger point.

Although the main embodiments of the invention relate to dome and roadway structures, other structures may be formed from the flexible bags such as bunkers, tunnels or reinforcing walls, placed in front of windows or doors of doorways.

Claims:

1. A blast protection structure comprising one or more rupturable containers, each of said rupturable containers being formed of a flexible bag having an aperture and filler cap so that fluid can be introduced into the bag and sealed therein to give substantial rigidity to said rupturable containers and to provide blast protection.

2. A blast protection structure as claimed in claim 1, wherein the bag or at least some of the bags are divided into internal chambers one above the other, with the lowermost chamber having a reinforcement layer.

3. A blast protection structure as claimed in claim 2, wherein the reinforcement layer is of Kevlar ® material.

4. A blast protection structure as claimed in claim 2 or claim 3, wherein the uppermost chamber has an external non-slip coating.

5. A blast protection structure as claimed in any preceding claim, wherein the flexible bags have tongues and grooves or rebates to enable adjacent flexible bags to interlock or to have some degree of interengagement.

6. A blast protection structure as claimed in any preceding claim, wherein flexible bags are used in conjunction with rigid bags to provide blast protection.

7. A blast protection structure as claimed in any preceding claim, wherein flexible bags are assembled in layers to form a dome to form an explosion containment structure.

8. A blast protection structure as claimed in any one of claims 1 to 7, wherein flexible bags are linked to one another to form a linear structure.

9. A blast protection structure as claimed in claim 11, wherein the linear structure forms a pathway over which persons or vehicles may travel.

10. A blast protection structure as claimed in any preceding claim, wherein the containers are arranged into a self-supporting wall.

11. A blast protection structure as claimed in claim 10, wherein the

containers are laid with their length arranged width-wise of the wall, whose length is built up with increasing numbers of containers.

12. A blast protection structure as claimed in claim 10, wherein the containers are laid length-wise, having a width appropriate to the width of the wall.

13. A blast protection structure as claimed in any preceding claim, wherein the containers, or sets of them, are interconnected for their filling from a single hydrant.

14. A blast protection structure as claimed in claim 13, wherein the interconnections include pressure relief valves and a hydrant connection to the lowest container, whereby the lowest container is filled first and each container up in the wall is filled next.

15. A blast protection structure as claimed in any preceding claim, wherein the containers are of waterproofed fabric material.

16. A blast protection structure as claimed in any preceding claim, wherein, to restrain the containers to a generally rectangular cross-section, the fabric of their top and bottom is conveniently of so-called drop stitch fabric, whereby the top and bottom skins are restrained to be parallel with each other.

17. A blast protection structure as claimed in claim 16, wherein the containers include sides and ends, which are stitched and/or welded to their top and bottom in a water-tight manner.

18. A blast protection structure as claimed in any preceding claim, wherein the containers filled with water.

19. A blast protection structure as claimed in any preceding claim, wherein the containers filled with a combination of water and air.

20. A blast protection structure substantially as hereinbefore described with reference to Figures 1 & 2 or Figures 3 & 4 or Figures 5 & 6 or Figure 7 of the accompanying drawings.

Application No: GB 0221863.4 **Examiner:** Sarah Harrison
Claims searched: 1-20 **Date of search:** 19 December 2002

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
A	-	GB 2335447	(Courtney)
A	-	GB 2299606	(Derbyshire)
A	-	WO 97/25551	(Courtney)
A	-	US 3957098	(Hepworth)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[T]:

E04B, E04H

Worldwide search of patent documents classified in the following areas of the IPC[7]:

E1D, E1G

The following online and other databases have been used in the preparation of this search report:

EPODOC, WPI & JAPIO